Detecting population changes in great crested newts: how much survey effort is needed?

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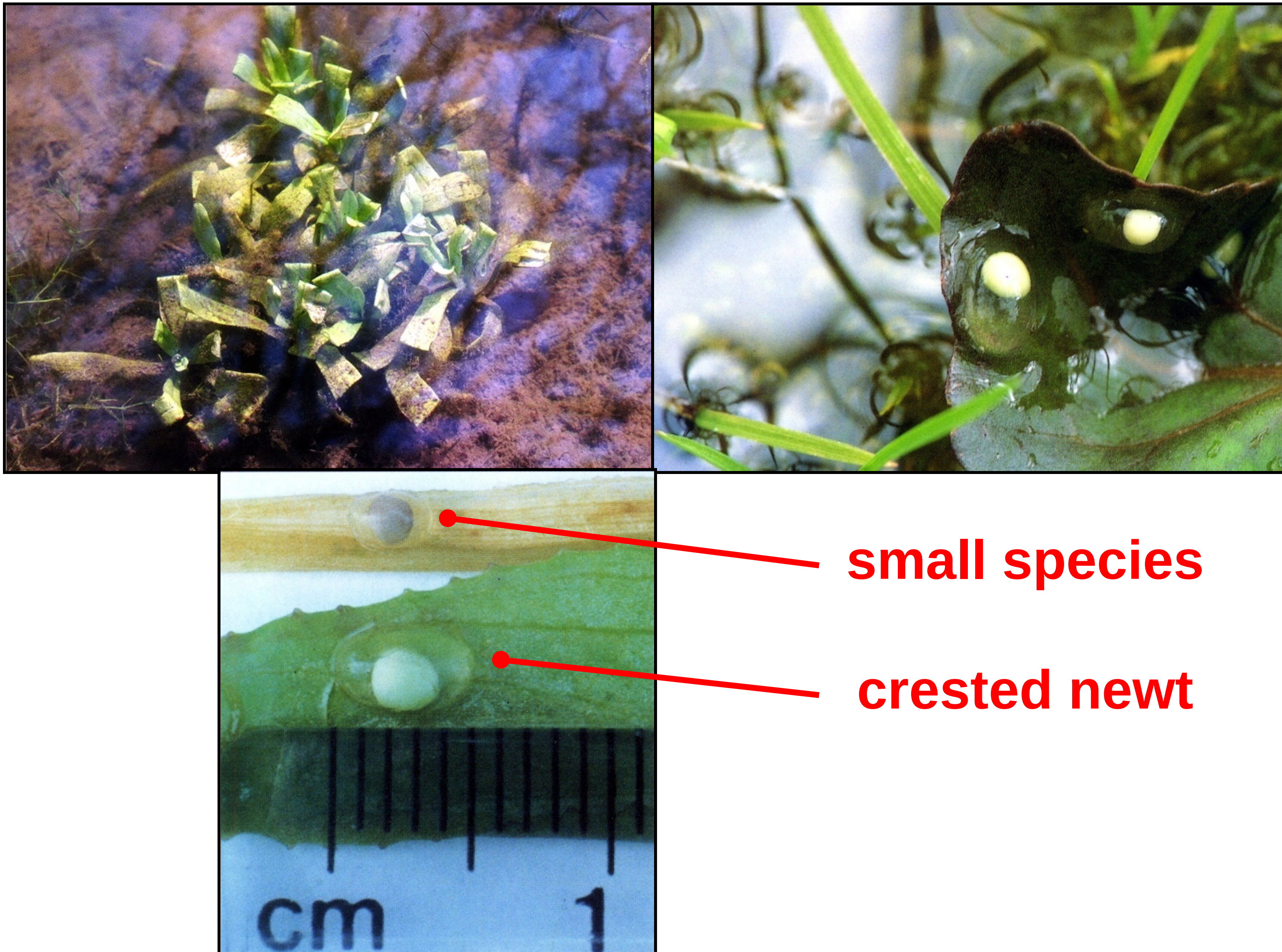
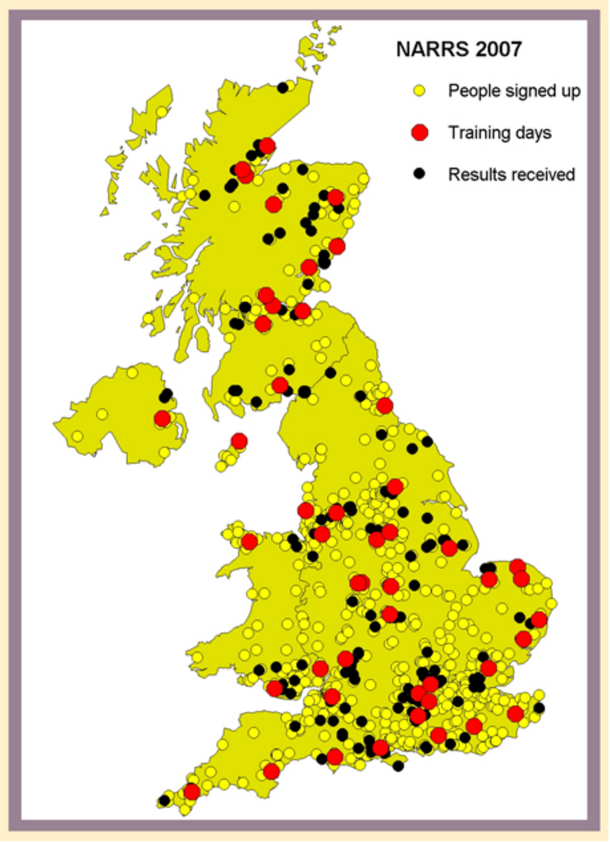
We shall torch count,
net and trap...!


PETZL


small species
crested newt
cm
1

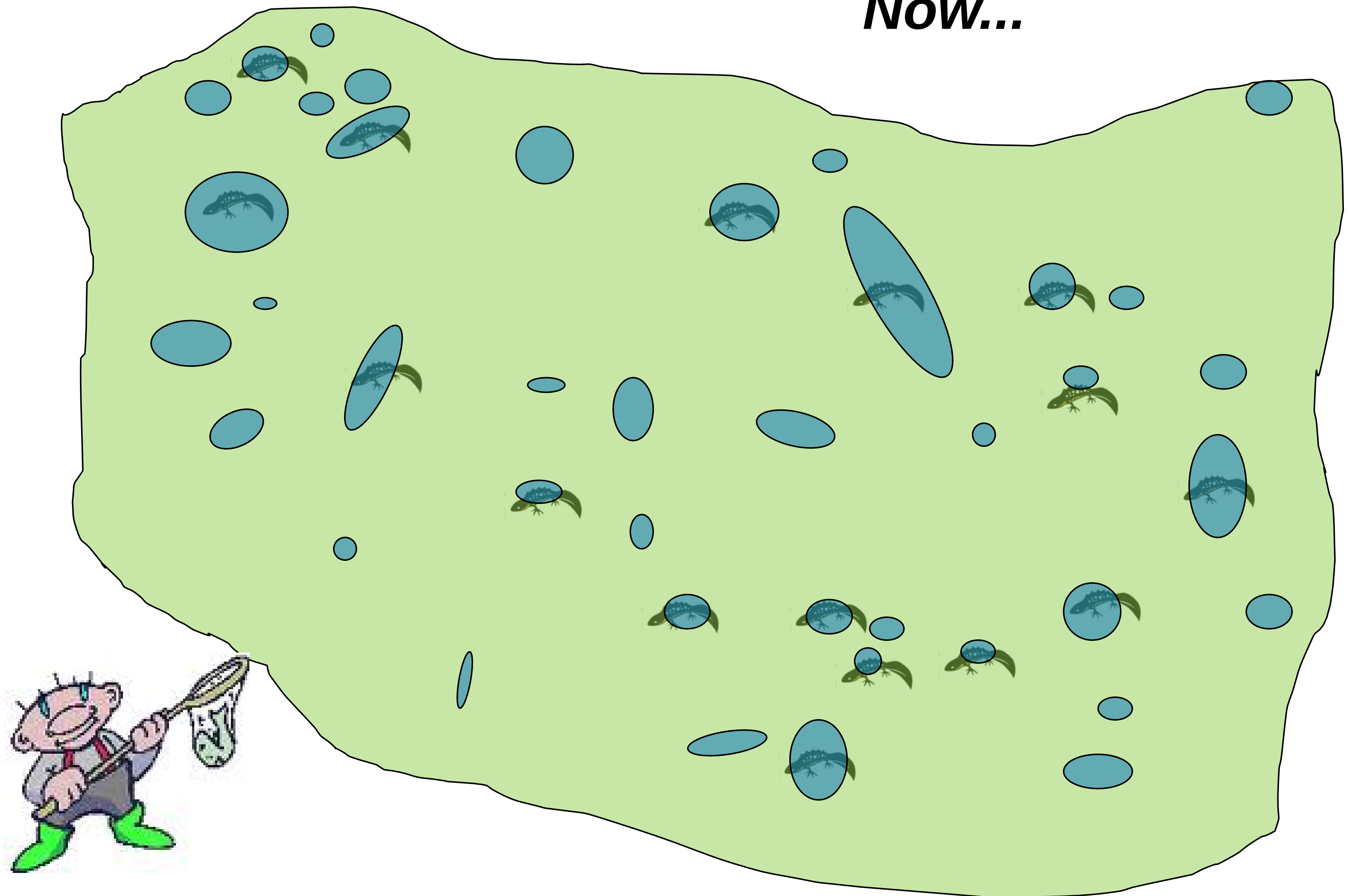
Existing NARRS Methodology

- Up to three surveys per year (March-June, ideally April-May)
- Ponds randomly selected
- Visual searches, torch lit surveys and netting used, any life stage recorded
- Volunteers trained in methodology
- **Is this methodology scientifically robust?**



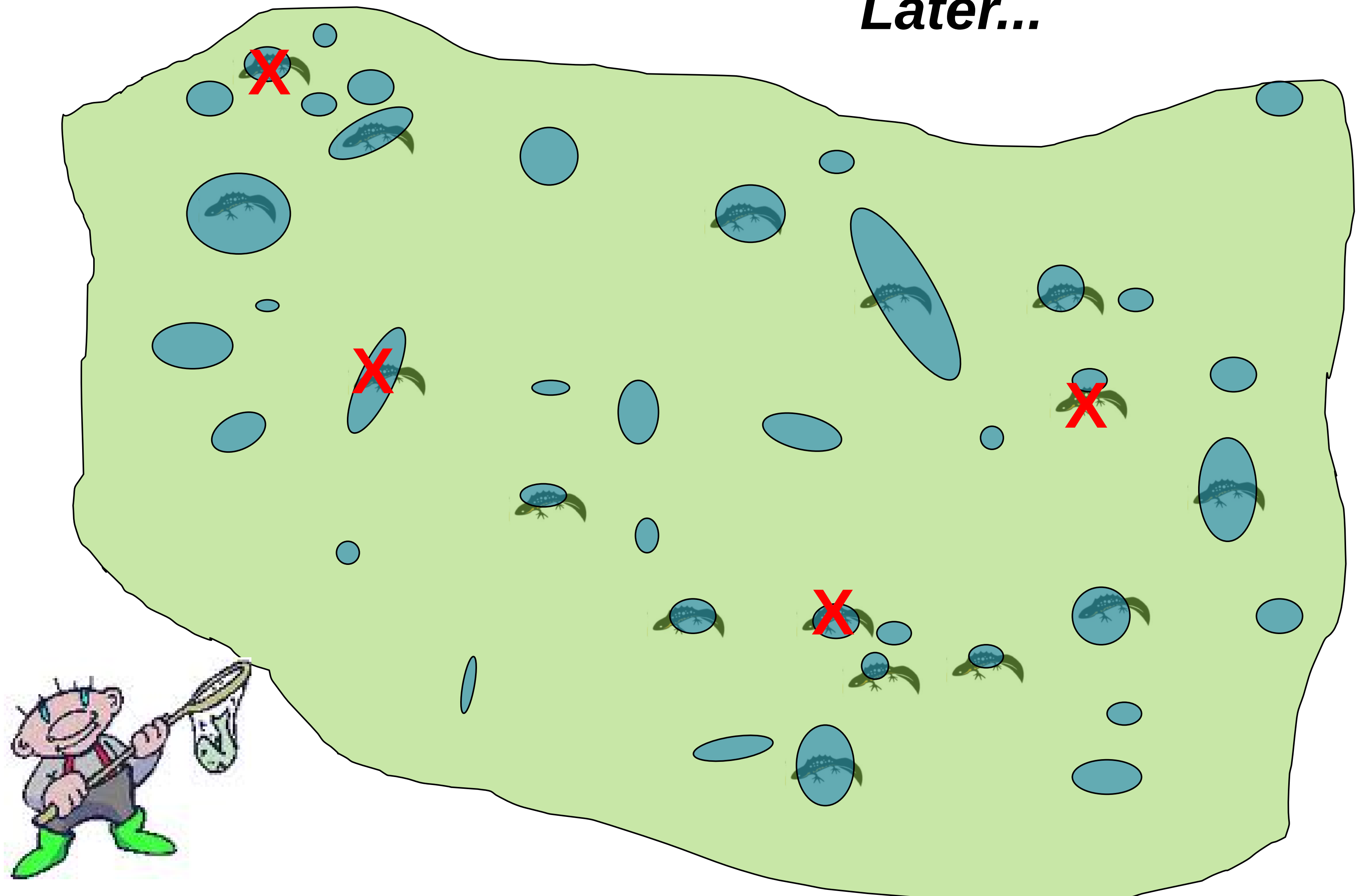
Detecting changes in population status

Now...



Detecting changes in population status

Later...



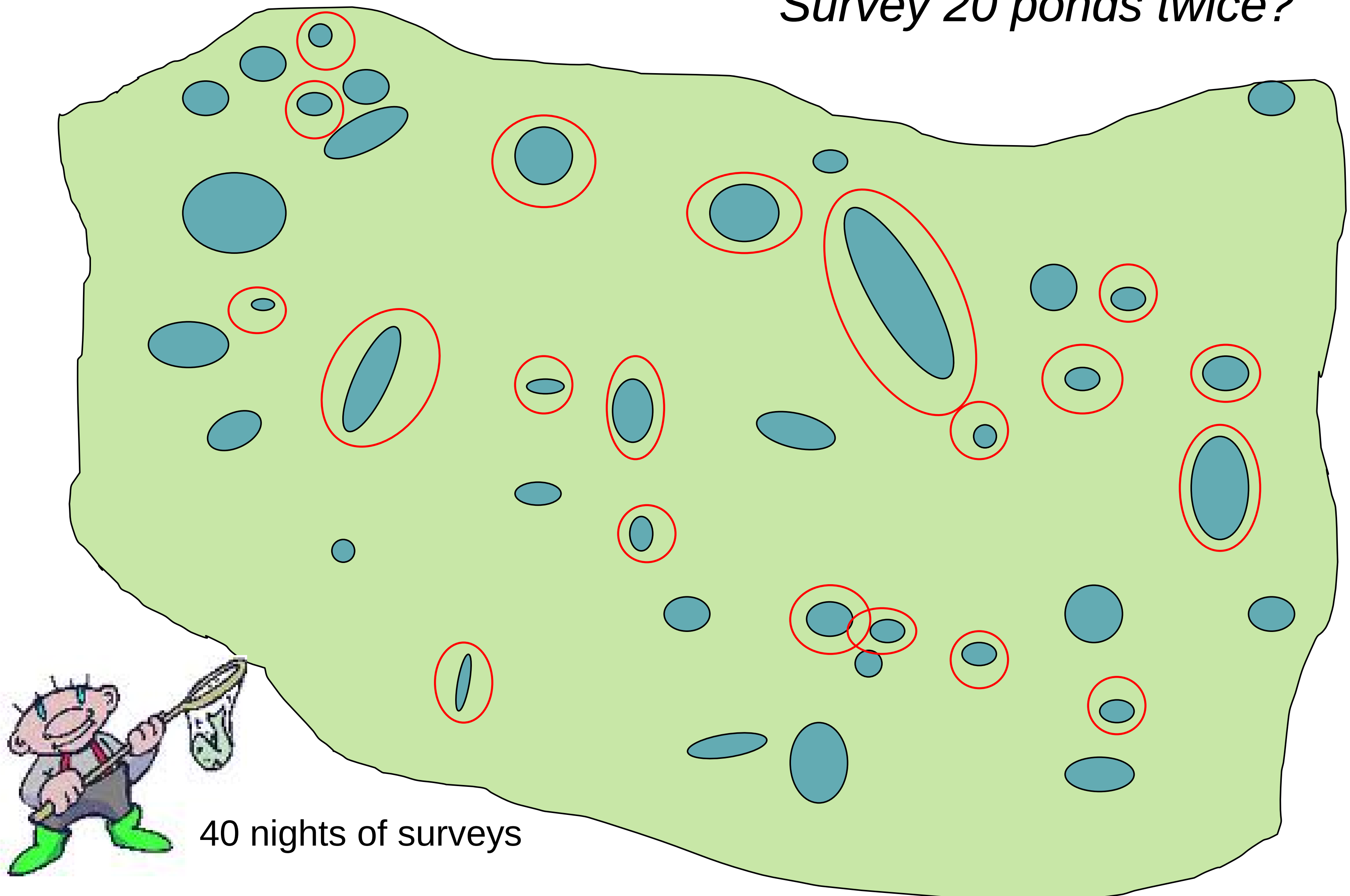
How many ponds and how many surveys?

Survey all 40 ponds once?

40 nights of surveys

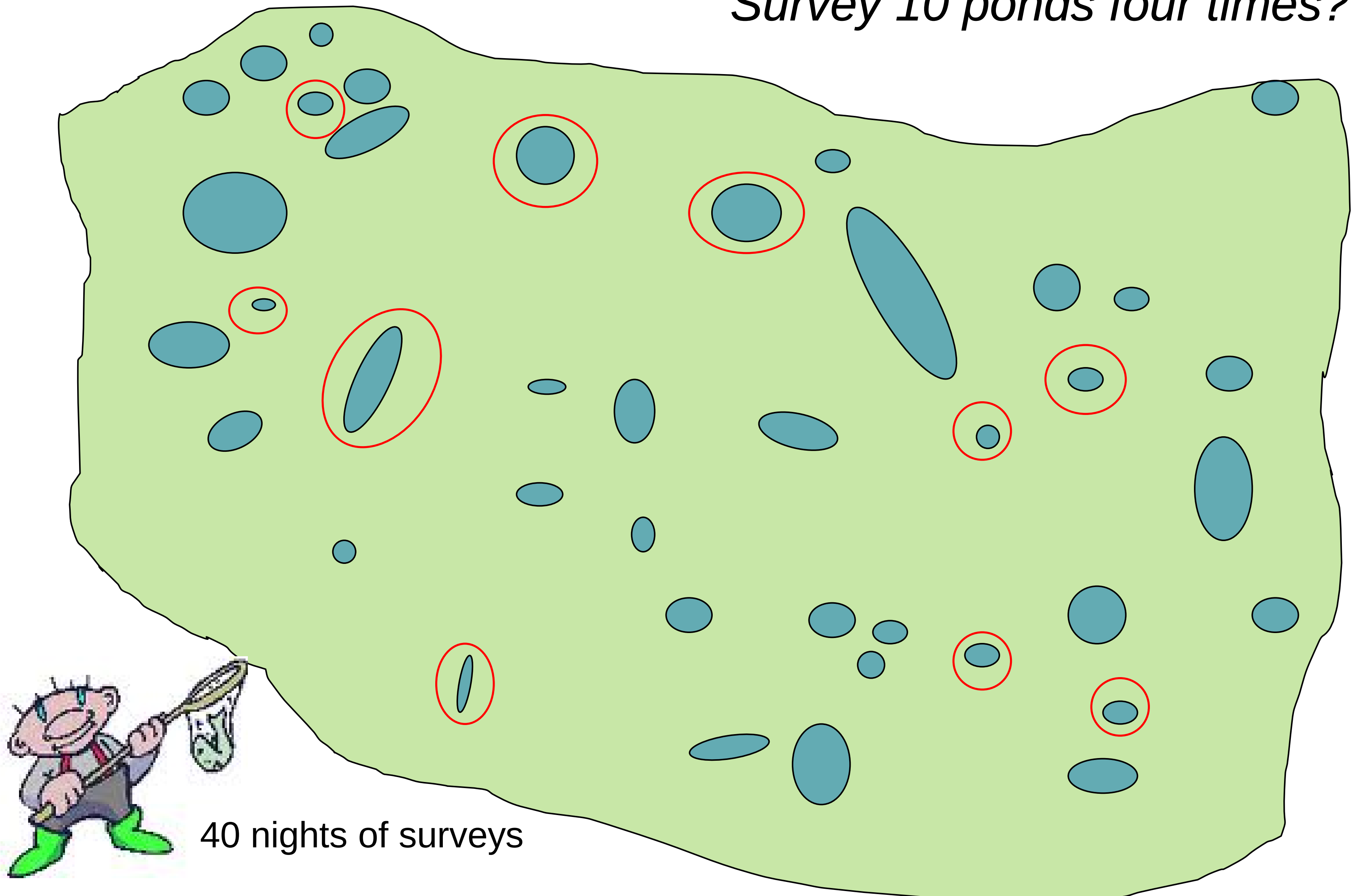
How many ponds and how many surveys?

Survey 20 ponds twice?



How many ponds and how many surveys?

Survey 10 ponds four times?



40 nights of surveys

BUT...
Detecting the presence of newts depends on:

- Survey methods used
- Number of survey visits
- Geography
- Experience of the surveyor
- Season
- Weather conditions...

....and more.

Problems:

Survey effort may be insufficient to detect population changes

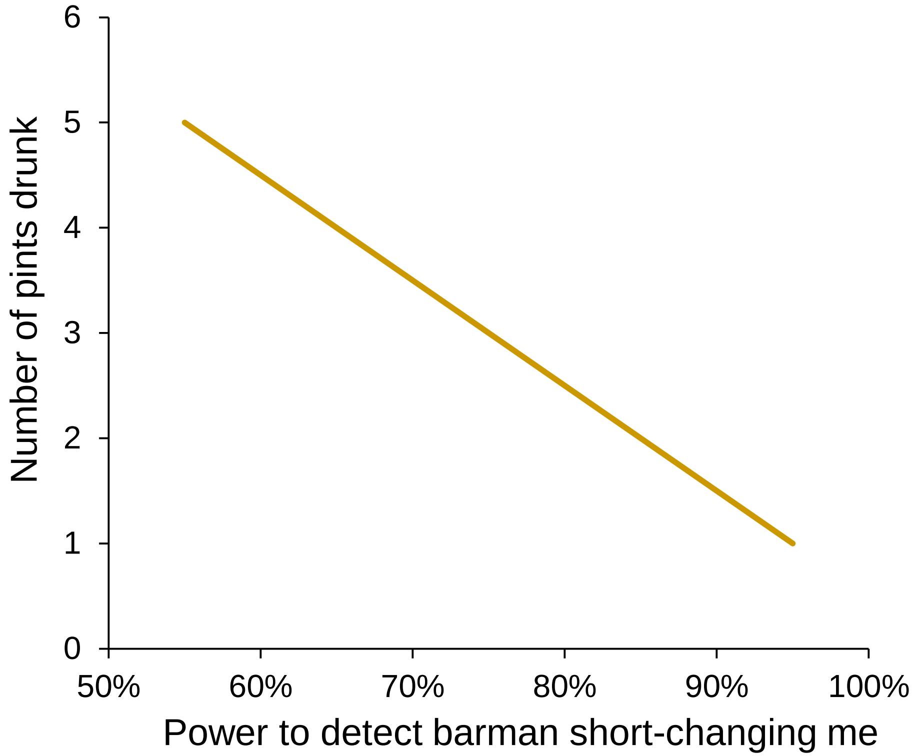
Power analysis

Newts may be missed when they are actually present

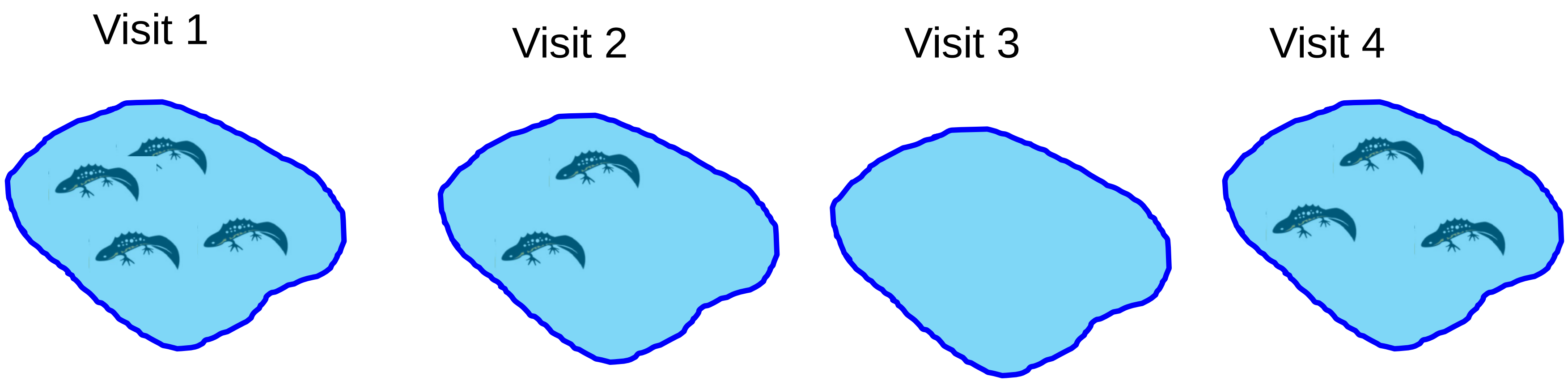
Occupancy modelling

$$\sigma^2 = \frac{\psi}{S}\left\{(1-\psi) + \frac{1-p^*}{p^* - Kp(1-p)^{K-1}}\right\} = \frac{\psi}{S}(1-\psi+F).$$

What is meant by ‘statistical power’?

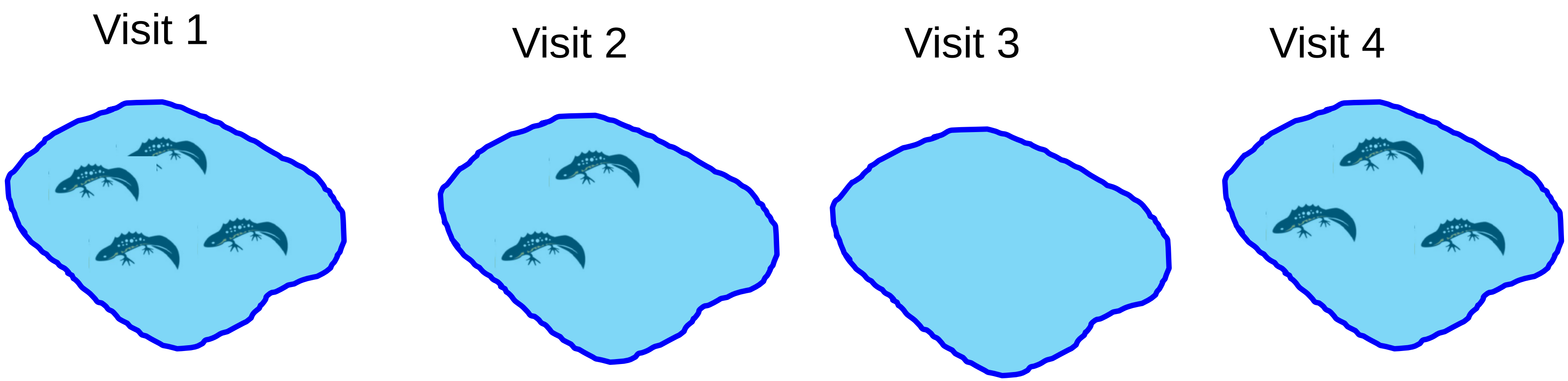


Occupancy modelling: now you see them, now you don't....



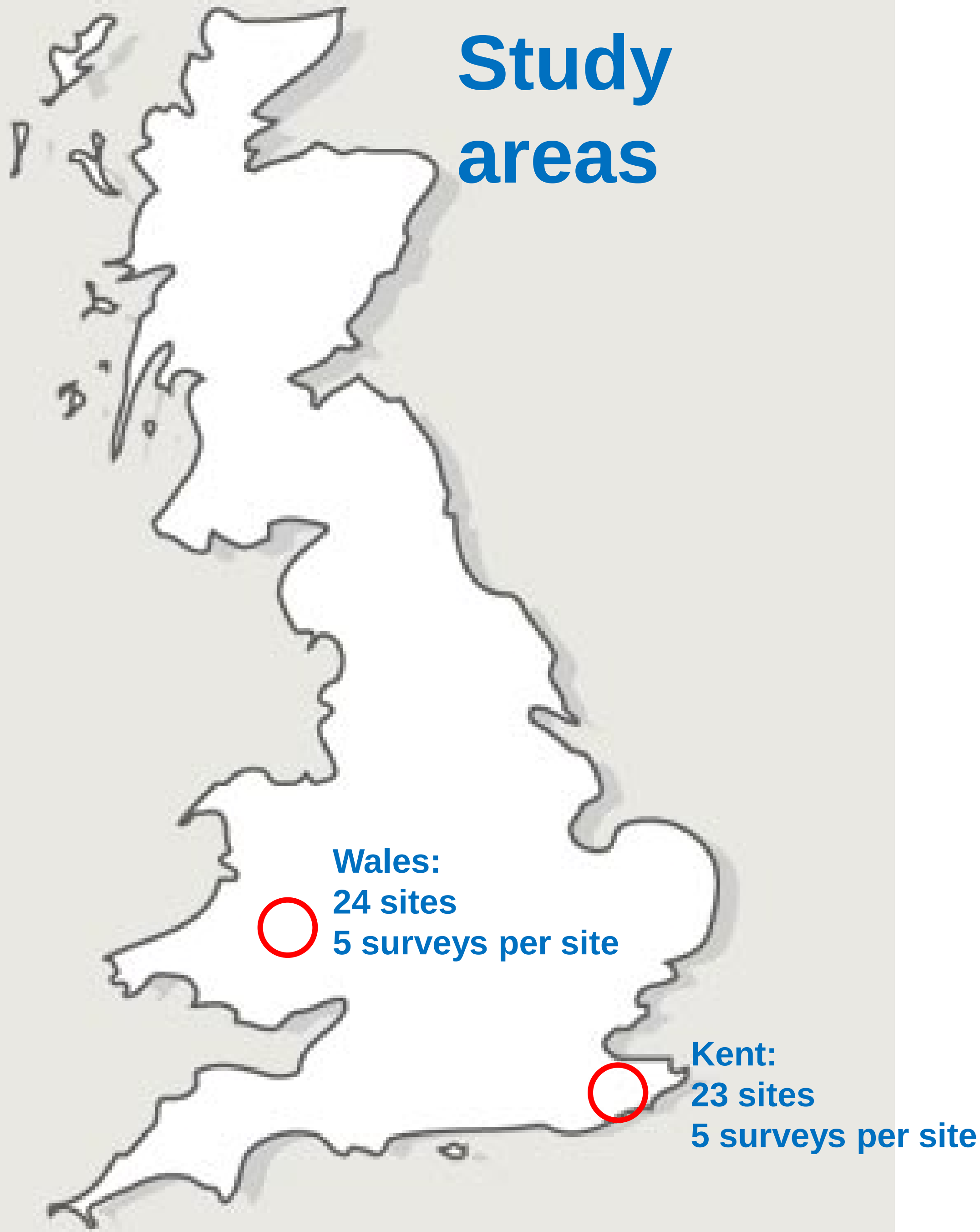
	Visit 1	Visit 2	Visit 3	Visit 4
Site A	1	1	0	1

Occupancy modelling: now you see them, now you don’t....



	Visit 1	Visit 2	Visit 3	Visit 4
Site A	1	1	0	1
Site B	0	1	1	0
Site C	1	1	1	1
Site D	0	0	1	1
Site E	0	1	0	0

Study areas


Wales:
24 sites
5 surveys per site
Kent:
23 sites
5 surveys per site

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability
Kent 2007	0.68
Kent 2008	0.62

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability	'Naive' occupancy
Kent 2007	0.68	0.30
Kent 2008	0.62	0.30

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability	'Naive' occupancy	Actual occupancy
Kent 2007	0.68	0.30	0.31
Kent 2008	0.62	0.30	0.31

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability	‘Naive’ occupancy	Actual occupancy	No. surveys needed (95% confidence)
Kent 2007	0.68	0.30	0.31	3
Kent 2008	0.62	0.30	0.31	4

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability	'Naive' occupancy	Actual occupancy	No. surveys needed (95% confidence)
Kent 2007	0.68	0.30	0.31	3
Kent 2008	0.62	0.30	0.31	4

4 methods: visual search, torch count, netting + TRAPPING

	Detectability	'Naive' occupancy	Actual occupancy	No. surveys needed (95% confidence)
Kent 2007	0.68	0.30	0.31	3
Kent 2008	0.56	0.35	0.35	4

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability
Wales 2007	0.38
Wales 2008	0.35

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability	'Naive' occupancy
Wales 2007	0.38	0.28
Wales 2008	0.35	0.29

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability	'Naive' occupancy	Actual occupancy
Wales 2007	0.38	0.28	0.32
Wales 2008	0.35	0.29	0.33

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability	'Naive' occupancy	Actual occupancy	No. surveys needed (95% confidence)
Wales 2007	0.38	0.28	0.32	7
Wales 2008	0.35	0.29	0.33	7

How many methods and how many surveys?

3 methods: visual search, torch count, netting

	Detectability	'Naive' occupancy	Actual occupancy	No. surveys needed (95% confidence)
Wales 2007	0.38	0.28	0.32	7
Wales 2008	0.35	0.29	0.33	7

4 methods: visual search, torch count, netting + TRAPPING

	Detectability	'Naive' occupancy	Actual occupancy	No. surveys needed (95% confidence)
Wales 2007	0.42	0.44	0.49	6
Wales 2008	0.41	0.41	0.45	6

How much survey effort is needed to detect a population change?

Assuming four survey methods for GCN and four repeat surveys at each site:

Magnitude of decline

Power to detect a decline		**10%**
	0.75	2466

How much survey effort is needed to detect a population change?

Assuming four survey methods for GCN and four repeat surveys at each site:

Magnitude of decline

Power to detect a decline

	10%
0.75	2466
0.85	3190
0.95	4616

How much survey effort is needed to detect a population change?

Assuming four survey methods for GCN and four repeat surveys at each site:

Magnitude of decline

	10%	15%
0.75	2466	1080
0.85	3190	1396
0.95	4616	2021

Power to detect a decline

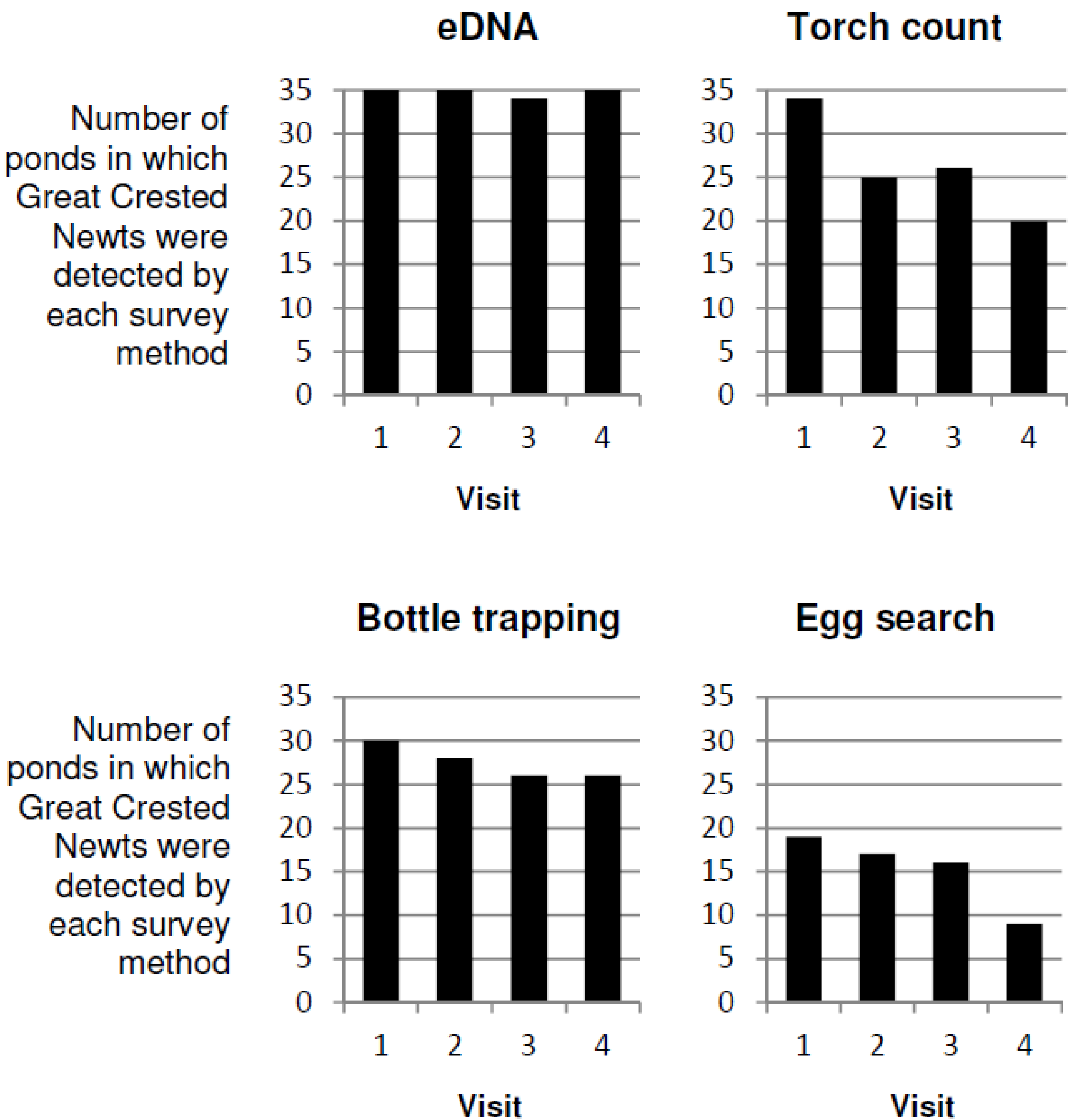
How much survey effort is needed to detect a population change?

Assuming four survey methods for GCN and four repeat surveys at each site:

Magnitude of decline

		10%	15%	30%
Power to detect a decline	**0.75**	2466	1080	256
	0.85	3190	1396	330
	0.95	4616	2021	478

What about eDNA?



Non-detection of eDNA can be due to:

(1) Water sampling protocol

(2) PCR protocol

From: Biggs, J., Ewald, N., Valentini, A., Gaboriaud, C., Griffiths, R.A., Foster, J., Wilkinson, J., Arnett, A., Williams, P., Dunn, F., 2014. Analytical and methodological development for improved surveillance of the Great Crested Newt. Defra Project WC1067. Freshwater Habitats Trust: Oxford.

Conclusions

- Optimal protocol may vary geographically
- Detectability of newts may vary geographically
- Models need testing over a wider geographical scale
- Detecting population changes reliably may require considerable survey effort
- eDNA…watch this space





Further information:

http://www.arc-trust.org/about-us/What-we-do/science-data/survey-monitoring

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Dynamics of a declining amphibian metapopulation: Survival, dispersal and the impact of climate

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ELSEVIER

Optimising biodiversity assessments by volunteers: The application of occupancy modelling to large-scale amphibian surveys

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ABSTRACT

Mobilising volunteers to carry out biodiversity assessments can help to
tion across broad geographical scales. However, even when volunte
absence surveys, there can be significant issues over false absences and
Simple but scientifically robust protocols are therefore required for thes
amphibian survey protocols for the National Amphibian and Reptile Re
ain, which aims to assess the status of five widespread amphibian spec
trained volunteers and researchers in two contrasting landscapes over 2
was used to determine covariates of detection, and to optimise the nu
methods required. Although surveys need to take into account seas
detectability of different species, there were also landscape effects.
harder to detect in ponds in Kent than in Wales, while the converse w
trapping to the suite of methods increased the detection of smooth a
and of great crested newts in Wales. Overall, reliable assessment of th
species at a site required four separate surveys, each using four differen
veys during both day and night, dip netting and bottle-trapping). Ou
finding the best compromises between rigor and simplicity when vo
surveys.

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    - National Amphibian and Reptile Recording Scheme

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Survey and monitoring initiatives

Conservation relies on finding out where animals occur, evaluating their status, and assessing trends over time. Perhaps surprisingly, there are still gaps in our knowledge about all of these. There is still more to learn about the species and how to survey for them. ARC is therefore engaged in a range of initiatives to improve our understanding, some of which we highlight here.

NARRS

National Amphibian and Reptile Recording Scheme (NARRS)

National Amphibian & Reptile Recording Scheme (NARRS)

General survey protocols

New methods for the analysis of survey data

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When Is a Species Declining? Optimizing Survey Effort to Detect Population Changes in Reptiles

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Abstract

Biodiversity monitoring programs need to be designed so that population changes can be detected reliably. This can be problematical for species that are cryptic and have imperfect detection. We used occupancy modeling and power analysis to optimize the survey design for reptile monitoring programs in the UK. Surveys were carried out six times a year in 2009–2010 at multiple sites. Four out of the six species – grass snake, adder, common lizard, slow-worm –were encountered during every survey from March-September. The exceptions were the two rarest species — sand lizard and smooth snake – which were not encountered in July 2009 and March 2010 respectively. The most frequently encountered and most easily detected species was the slow-worm. For the four widespread reptile species in the UK, three to four survey visits that used a combination of directed transect walks and artificial cover objects resulted in 95% certainty that a species would be detected if present. Using artificial cover objects was an effective detection method for most species, considerably increased the detection rate of some, and reduced misidentifications. To achieve an 85% power to detect a decline in any of the four widespread species when the true decline is 15%, three surveys at a total of 886 sampling sites, or four surveys at a total of 688 sites would be required. The sampling effort needed reduces to 212 sites surveyed three times, or 167 sites surveyed four times, if the target is to detect a true decline of 30% with the same power. The results obtained can be used to refine reptile survey protocols in the UK and elsewhere. On a wider scale, the occupancy study design approach can be used to optimize survey effort and help set targets for conservation outcomes for regional or national biodiversity assessments.